ARTICLE XXVI.

Notes and Diagrams, illustrative of the Directions of the Forces acting at and near the surface of the Earth, in different parts of the Brunswick Tornado of June 19th 1835. By A. D. Bache, Professor of Natural Philosophy and Chemistry in the University of Pennsylvania; one of the Secretaries of the American Philosophical Society. Read April 2d 1836.

In company with my friend, Mr Espy, I visited, in the early part of July last, the scene of the destructive tornado of June 19th, the ravages of which had been most severely felt in New Brunswick, New Jersey, and its vicinity; the effects extending about seven and a half miles to the west, and ten to the east of that place. The idea of illustrating these effects by the aid of instrumental means, first occurred to me after hearing an interesting account by professor Johnson, before the Academy of Natural Sciences of this city, of an examination made by professor Henry and himself of the position of materials carried by the storm from the city of Brunswick, and deposited in a field on the opposite bank of the river Raritan.

The regularity in the general arrangement of these materials gave me the hope that further facts of interest might be brought to light by an examination of the country along the path, and fully established, as well as clearly represented to the eye, by diagrams laid down from actual measurement.

To this point I devoted exclusive attention during the limited time which a very brief recess from duty at the University afforded me. Mr Espy collected at the same time the accounts of those who had witnessed the phenomenon, examined closely the general circumstances, and is equally concerned with myself in any claim to novelty in the results about to be submitted. As he will embody the deductions from the information collected and from the general observations which we made, I do not propose to go into them further than is necessary to make my results intelligible.

The accompanying diagrams, Plates XXIII. XXIV., represent different portions of the track of the storm, from the point at which its effects were first felt in any considerable degree, to a point about a mile east from Brunswick, where I was reluctantly obliged to close my observations.

They were obtained by means which, though rough, are abundantly exact for such a purpose, namely, by measuring the angles to be taken, by the compass, and by pacing the short distances to be estimated.

Such an examination being made of the track of the tornado through a wood, or in any other suitable case, the directions of the acting forces are determined, and thus is ascertained whether they correspond to the effect of a whirl at and near the surface of the ground, as is generally assumed, or to that of a rushing wind, or, as most fully appears, to that of a mighty column of rarefied air in motion.

Although the action of the storm on buildings affords many interesting facts in regard to the phenomenon, and in one case, an effect of great interest was thus first pointed out; yet, as we expected, the most satisfactory evidences of the directions of the forces occur, generally, in open woods, and in the plantations near buildings.

It may seem superfluous to a reader accustomed to observation to say that entire regularity is not to be looked for in the effects to be brought before him. I have, however, thought it best to remark briefly upon some of the causes which might be expected to produce considerable irregularities, in the positions of trees overthrown, or broken, by the storm.

The soil of the part of New Jersey through which this storm passed is a red clay (from the red shale), and deficient in strength. The trees

growing upon it extend their roots very far horizontally, while they penetrate but a short distance below the surface. They are therefore readily uprooted, and in the overthrow carry a considerable extent of soil with them.

If the forces acting during the whole period that the trees were within the sphere of action of the storm, be supposed of equal intensity but varying direction, then the trees extending their roots unequally in different directions, will oppose unequal resistances in those directions, and two trees side by side may be thrown different ways. Several trees presenting thus a want of conformity of direction, would induce, at first view the idea of a total want of regularity calculated to baffle observation. If the forces vary in intensity as well as in direction, this difficulty will be increased. Again, the circumstances of the proximity of other trees may not only influence the direction in which a tree will fall, after its motion has commenced, but the very direction in which the force producing its fall may act. And these remarks apply in even greater force to the case in which trees are broken, instead of being overthrown.

The unequal strength of parts of a building, and its protection by adjacent buildings must produce difficulties of a similar kind; while in the trees near to houses we should look for even more irregularities of direction, than in those in an open wood.

These remarks, it will be seen, are not intended to set aside any cases which may appear inapplicable to a general conclusion, but merely to guard against unreasonable requirements.

Of the diagrams, figures 1, 4, 5 and 7, are drawn to the same scale; the scales of figures 3 and 6 are attached to them respectively; and figure 2 is not drawn to a scale.

The directions of the trunks of the trees are represented in all but figure 1 by arrows. In order to make these directions appear distinctly, these arrows are out of proportion to the horizontal distances between the trees. This causes the tops of trees to appear very near, which, in many cases, were not so.

The first point to which we traced the action of the storm, was near the farm of Mr M. S. Garretson, about seven miles, a little south of west, from New Brunswick. It crossed the Millstone river, and the

Trenton and Brunswick canal, about half a mile to the west of Mr Garretson's dwelling, and its track was between this house and a barn about sixty yards from it. A small portion of a light fence and some other matters were carried across the road upon which the house fronts, and a part of the trees in an orchard thrown down. Neither the barn nor dwellinghouse was injured, and the action was described as that of a strong wind of limited breadth. In the orchard the trees to the south of the path of the storm were thrown northwardly and those to the north southwardly. Passing on to the east, the next effect was seen in overthrowing a large cherry tree, and carrying off the south-west corner of the thatched roof of a small saw-mill. The most violent action, however, at this place was upon a wood nearly east from the dwellinghouse, and is shown in the sketch figure 1, Plate XXIII. This is, perhaps, the most hasty of all the determinations which I made, as the interest which attached to the effects wanted the force of novelty: they being similar to those referred to, as observed by professors Henry and Johnson. The ground represented in the diagram is irregular, consisting of a hill, the sides of which are covered by wood; the hill being cut by a ravine which was apparently near the northern border of the storm, or of that part in which the trees were thrown in the direction of its course. The wood was of young hickory and black oaks without undergrowth, but even here some irregularities were seen. The spiral growth of a few of the trees had led the proprietor of the farm to think, and speak, of the whole effects as produced by a whirlwind. He pointed out those cases, which were, obviously, seen to have resulted from the cause which I have just assigned. It will be observed in the figure that of nine trees there represented, the two on the north side of the storm fell southward and eastward, one, *g*, points out its direction nearly, and five of the six of the south side are directed between N. 10° E., and E. 40° N. The breadth of the storm was here about 200 yards, and its direction about that of the line A B.

We next repaired to a point where the destruction was reported to have been considerable, namely, to the farm of Mr D. Polhemus, between two and three miles E. 17° N. from Mr Garretson's. Here a very curious fact was developed, which I have attempted to represent in the sketch and ground plan figure 2, Plate XXIII. The building or

shed attached to a large frame barn, and on the southern side of it, was moved during one part of the phenomenon to the west of north, and subsequently to the eastward. The posts (see b, figure 2) slipped from the stones, a, which supported them, when the building was first acted upon by the storm, and moving northward and westward ploughed a furrow, c, in the soft surface of the ground, heaping up the manure, d, before them. Afterwards, being moved eastwardly, they formed another furrow, e, and a heap of manure, f, remaining in the position, b, when they were pointed out to us. As the first direction is nearly at right angles to that of the motion of the storm, the building being to the south of its axis, the conclusion is irresistible that there was, on the approach of the storm, a tendency to motion *towards* it. The second furrow shows a motion towards the receding storm. Why this building moved but in two directions will appear from the protection afforded to the north east by a large barn, the strength of which enabled it to bear the tendency towards the moving meteor, without much injury. In figure 3, D is the shed, C the barn, and FG the probable direction of the storm, the probable axis nearly coinciding with that line. It is believed that the relative positions of the buildings there shown, are nearly correct; no particular pains were, however, taken on this score, a survey of the orchard to the east of the house being the main object.

Of the trees in this orchard, figure 3, more than two-thirds suffered; being generally torn up by the roots. Of these there are two lying actually west of north, and seven thrown to the north of north east; while the greatest amount of devastation is in the direction of the meteor, which passed over the western part of the orchard, the inclination of its path being about 10° N of E. It is remarkable that some small trees, as n and o, were left standing, and were not much broken. Some large trees, as between s and g', were also left. The former ones had probably sufficient flexibility to give way to the action of the storm without breaking; c', b', a', f' and z were probably uprooted on the approach of the storm. The tree y presents a curious case: it is broken into three parts, the middle one lies north, and the two exterior ones are separated from it to the eastward and westward. It will be observed that the trees lying perpendicularly to the track of the storm, are not those furthest from the centre of that track.

While the trees on the southern edge of the storm were thrown generally northward and eastward, the few which were on the north side, were thrown to the southward. Thus at i' is shown a large black cherry tree, uprooted and lying nearly parallel to the side of the house A, while at k' and l' are groups of willows, the limbs of which were broken off, and thrown to the southward and eastward. There were no trees in the meadow to the north of the orchard and east of the group k'.

We were told by Mr Polhemus that the orchard of a neighbour to the west of him had been prostrated, but did not consider it advisable to return upon that point, determining rather to follow the track of the storm towards Brunswick. The general direction of Brunswick from Mr Polhemus's house is E 10° N.

We explored the wood belonging to Mr Polhemus, and eastward from his dwelling, where the marks of the tornado were next to be seen. As, however, nothing of special interest was developed, I have not thought it necessary to copy the drawing made from my notes. Passing through this wood, the track was marked through fields of grain and orchards in which the trees were uprooted, and near buildings which suffered more or less from its action.

The next point of interest occurred where we distinctly made out that the meteor did not maintain its position at the surface of the ground; a fact which has before been observed in regard to other tornadoes. After a slight damage upon the edges of a thick wood of black oak trees, the marks of destruction were not seen until traced upon a ploughed field, to the east of the wood, in which there were a few trees. These were uprooted, and the moist earth from the surface of the field was thrown against the trees of an adjacent wood.

The next diagram, figure 4, represents a very remarkable case, establishing conclusively the direction of the forces already pointed out in figure 2, but in a case less complicated than the former.

In a tolerably open wood, we lost all traces of the storm, but pursuing a general easterly direction, came upon a part of its track where the trees were broken near the top. A little further on they were broken nearer to the trunk, and at last uprooted. A survey of the exterior of a circular space around which the trees were overthrown, gave the

accompanying representation, figure 4. The round was traced by the directions of the trees; that is, having set out at one point, I arrived at it again, by following the indications afforded by the directions of the trees. In the mean time Mr Espy explored the interior of the round, and pointed out to me a space where the tops of the trees were lying together. The evidence of a rush towards a central space is thus conclusive.

To generalize the results of this diagram, it will be seen, that with a few exceptions to be remarked upon directly, all the trees on the southern border of the circular space A, are thrown northward; those to the north southward; to the east westward, and to the west eastward.

These exceptions are probably to be referred, generally, to the forward motion of the spout. Thus, while c is thrown to the west of north, a tree beside it, and many like p to the south of it, were carried in the general direction of the moving column. The same is true of trees to the north of g and h. In selecting the trees to be noted, I took care to put down cases which seemed anomalous, lest something of consequence should escape observation. The irregular positions of the tops of trees at i, seem to be sufficiently explained by their interference in falling. The tree g may have had its top carried northward in falling, and lies almost directly opposed to the directions of trees to the north of it; these trees being bent permanently, but not broken. Pursuing the track of the storm along B C, the trees were thrown in its general direction.

Passing forward to the east, we lost the traces of the storm, and when they appeared again, the circumstances seen in approaching figure 4 were repeated. Figure 5 represents the recurrence of the effects produced by the descending of the column to the ground. I did not think it necessary to go round, with the compass, that part of the circle which is turned in the general direction of the motion of the spout, but merely the other portion which presents the curious circumstance of trees thrown in a general direction opposed to that of the motion, proving conclusively that a rushing wind from the westward will not explain the effects. The fatigue incident to the previous work made me very willing to cut off all that seemed of doubtful utility.

The next position surveyed, was at and around the dwelling of Mr David Dunn. The destruction here was terrible indeed. The dwellinghouse had been unroofed, and otherwise severely injured. A large barn and stable had been torn down, the outhouses prostrated, and all the trees around the dwelling uprooted or broken to pieces. The storm had passed from an adjacent wood, about one-sixteenth of a mile to the west. All this destruction had been accomplished and an entire calm taken place, in the time that Mr Dunn ran from the front to the back door of his dwelling, a distance of about thirty feet. This excessive rapidity of motion was no doubt one of the causes why lives were not lost, in vain attempts to escape from the effects of the storm.

Mr Dunn received us with great kindness, and gave every information in his power without expressing weariness at our curiosity. Indeed it is but justice to say here that we met with uniform courtesy and kindness, along the whole route of our inquiry, and experienced no case where those whom we addressed were unwilling even to leave their work, to point out to us matters worthy of attention. For this attention we beg leave thus publicly to return our thanks.

A general glance at sketch figure 6 will serve to show that the trees near the house were thrown inwards. No case occurs in which the trees are thrown outwards from the house. Many, however, further to the north and east of the house, and which are not represented in the sketch, were carried in the direction of the storm. A closer examination will serve to show several interesting particulars.

Of twelve trees in the row A B, south and west from the dwelling, all but three were injured, and generally uprooted. The three not injured were young black cherry trees, two were of "medium size," and the other quite small. Six of the trees were thrown between N. $4\frac{1}{2}^{o}$ W., and N. W., or *towards the approaching spout*. Three were thrown towards the house, namely, the one nearest to the house, and two furthest from it: all these are large trees. Of the trees around the house, all those uprooted or broken, except *q* and *k*, point towards the house, and these were evidently caught by the trees to the west of them. *s'* presents a curious case: the tree was broken off, and the fragment carried towards the west; then, by a subsequent force, laid in the position *s'*, E $7\frac{1}{2}^{o}$ S. The tops of *m*, *n* and *w* were lying together in a heap, and the limbs from the trees in this group, together

with palings from a fence to the west of the house, and fragments of the outhouse, C, were strewed at *x*. *u* and *t* have received their direction probably from the onward motion of the spout, which heaped an immense mass of rubbish against the west side of the house, breaking it in, and destroying nearly every article of furniture in the south-west room. The house, and the area just described to the north of it, seem to have been the scene of this inward rush. The facts to prove that it was also an upward one, will be stated by Mr Espy. The trees in a field to the north of the house, and beyond *u*, *t*, *s*, *o*, were carried eastward in the general direction of the storm; and in a field still further north, the rafters from the roof of the dwelling A were found.

Two rows of trees extended from the south side of the house to the road. These do not appear to have suffered as much as the row to the west of them. In the nearest position of the spout, they were in part protected by the house. The trees which were uprooted lie in directions extending over the sector between N. 15° W. and N. 45° E.; much the greater number of trees being thrown between north and north east.

A tree at *d'* was thrown against a small porch to the north of east of it.

As the destruction to the eastward of this house renders it improbable that the axis of the spout did not touch the ground there, it seems to me that this inward rush indicates that the spout had its velocity *momentarily* checked at this point.

On the following day we examined a wood to the east of Brunswick and on the opposite side of the river Raritan. This wood is to the east of the position examined by professors Henry and Johnson, from which the debris inspected by them had been removed.

The case here presented was so complex, that I doubt much if we could have unravelled it without previous preparation. The irregularities encountered on the southern edge, see diagram figure 7, detained me so long, that I was only able generally to sketch the northern borders, the directions of the trees being, however, still taken with the compass. The inward direction of the forces is here well made out, notwithstanding the confusion produced by the subsequent forward

rush of air. While I was engaged in obtaining materials for this sketch, Mr Espy penetrated further west into the wood and beyond it. He states that the marks on the trees indicate a downward motion of the spout at this place, more obscurely made out than in the other cases before described. The nature of the ground to the west of the wood was unfavourable to an exact determination of this point, but it is probable that the spout was raised, for a short distance, above the surface of the ground.

As far as the examination of the different diagrams has shown, I think it entirely made out that there was a rush of air, in all directions, at the surface of the ground, towards the moving meteor; this rush of course carrying objects with it. That the meteor did not always extend to the surface of the ground, and when at the surface did not move uniformly either in velocity or in direction.

In figure 1 there is no motion towards the approaching meteor exhibited; and this appears generally to have been the case along its track when moving uniformly and reaching to the surface of the ground. The reason of this readily appears, for the air in front of it would hardly be in motion, the trees carried by it hardly bent, before the second and more violent action would prostrate them in the general direction of the motion of the meteor.

Figures 2 and 3 exhibit cases of this motion in both directions, towards the approaching and towards the receding meteor. But there is no evidence here that the spout was not moving along the surface. In the case of figure 2, the motions were registered by the effects upon the ground, and the easily uprooted trees shown in figure 3, fell in directions, with one exception, between 10° W. of N. and 3° N. of E.: the meteor moving about 8° N. of E., and to the north of the orchard containing the trees.

The disappearance of the track of the storm is first satisfactorily made out in the remarks subsequent to those upon figure 3. The effect of a second case of the sort is represented in figure 4, where around a circular space, in which the tops of the trees were found lying together, is a ring in which the trees generally point to the central space. At the outlet, where the storm moved on its track, the

trees are found in the ordinary directions, and the same is true to the eastward of the place in which this descent of the spout occurred.

A second case of the same kind is represented in figure 5. At Mr David Dunn's, the evidence is against such a descent having taken place at the dwellinghouse, as shown by the row of trees to the south and west of the house, see figure 6, and by the fence, trees and shrubs of the garden to the west of the house. Yet the dwelling appears as a centre, towards which objects to the north and east of it were thrown. To account for this I have supposed a momentary, and the evidence shows that it was merely momentary, pause or check in the velocity of the meteor. Such pauses were represented to us by many spectators to have taken place, and sometimes in cases where they could hardly have been deceived. In figure 7 is shown a case in which it is doubtful whether the effects are those of a check of velocity, or of a descent of the spout; most probably both took place.

These effects all indicate a moving column of rarefied air, without any whirling motion at or near the surface of the ground.

References to the Diagrams on Plate XXIII.

Figure 1.

Wood of Mr M. S. Garretson.

a. Tree uprooted,* N. 20° E.
b. Broken off, lies N. 10° E.
c. Hickory torn up by roots with a sapling alongside, N. 38° E.
d. Top of a black oak blown off, carried to E. 40° N.
e. Hickory broken off about two feet above the root, lies E. 1° N.
f. Black oak broken off at the root, E. 41° N.
g. E. 15° N., about thirty yards from the north edge of the storm.
h. The south east corner of Mr Garretson's house bears W. 3° S. from this point.
i. A sapling bent over and kept in place by other trees, E. 30° S.
k. A sapling bent to E. 36° S.

Figure 2.

Outhouse of Mr D. Polhemus.—Ground Plan.

a. A flat stone, on which the post b originally stood.
b. Present position of the foot of the post.
c. Groove made in earth to northward of a by the post.
d. A mound of manure heaped up at the end of the groove c.
e. A second groove north of east in direction.
f. A mound heaped up by the post b two feet high.

Figure 3.

Grounds of Mr D. Polhemus.

A. Dwellinghouse of Mr Polhemus, slightly injured.
B. Outhouses not injured.
C. Barn, shingles torn off, not many in number.
D. Shed shown in figure 2.
E. Open work corn crib, not injured.
a. N. 12° E. Uprooted.†
b. Tree uprooted, too crooked to determine its direction.
c. N. 6° E.
d. N. 27½° E.
e. E. 20° N.
f. Tree standing near the fence.
g. E. 6° N.
h. E. 3° N.
i. E. 3½° N.
k. E. 18½° S.
l. E. 25° N.
m. E. 18° N. Tolerably straight. Shingles from barn found at the foot of m. Southeast angle of the barn bears W. 30° S.
n. Tree standing.
o. Low tree standing: small.
p. N. 32° E.
q. Broken, not uprooted.
r. N. 27° E. Dead: bushy.
s. Standing. High and stout.
u. N. 24° E.
v. Plum tree near, standing.
x. N. 5° E.
z. N. 9° W. Small, firmly rooted in north side.
y. Thick and bushy: broken off into three parts, the smallest of which points west of north, the next north, and the largest east of north; the bark is stripped off below the fracture.
a'. N. 4° E.
b'. Same general direction as a'.
c'. N. 2½° E. Small roots.
d'. E. 22° N. Very large roots.
e'. N. 10° E.
f'. N. 10° W. A small tree near this, in the same row is untouched.
g'. E. 35° N.
h'. E. 3° N. Three trees at the south end of the row f' g' are standing.
i'. A very large black cherry tree, uprooted, and lying nearly parallel to the house.
k' l'. groups of willows, the limbs and branches of which are torn off, and thrown to southward and eastward.

Figure 4.

A wood.

a. N. 40° E. Uprooted.
b. N. 35° E. Several in the same general direction.
c. N. 29° W. The top of a tree has fallen on c and nearly at right angles to it.
d. W. 12° N. Uprooted.
e. W. 42½° N.
f. W. 13° N.
g. W. 4° N. It lies N. 15° W. from c, and about one-eighth of a mile from it.
h. S. 23° W. One of the last trees near the edge.
i. Top blown E. 36° N., large end foremost. Another top at right angles.
k. Top blown off E. 0½° S.
l. E. 7½° N. A tree near l is broken off and top lying to west, obviously could not go to eastward on account of the other trees.
m. N. 23° E.
n. N. 15° W. Many large and small trees, not varying in direction 5° from the direction in which this has fallen.
o. Is the same as a. Being at once the point of departure and of termination. b was also examined and identified.

* The trees are uprooted unless the contrary is stated, or shown in the figure.
† The directions of the arrows indicate those of the trunks of the trees.

PLATE XXIII.

Fig. 1.

WOOD of Mr M. S. GARRETSON.

Scale as of fig 1.

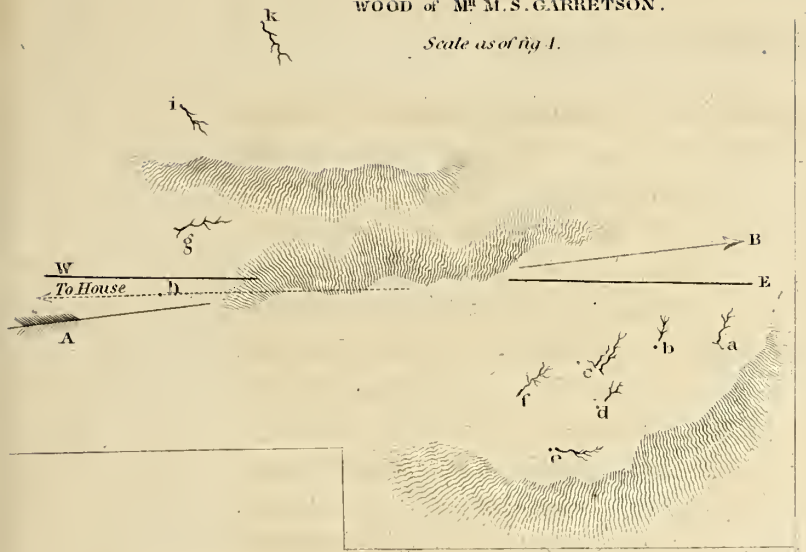
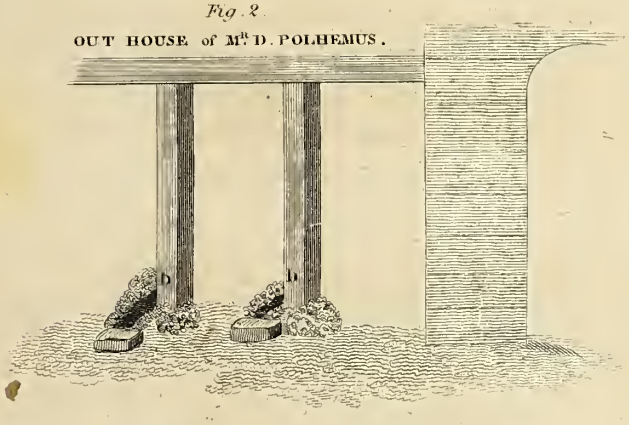


Fig. 2.

OUT HOUSE of Mr D. POLHEMUS.



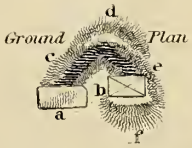


Fig. 4.

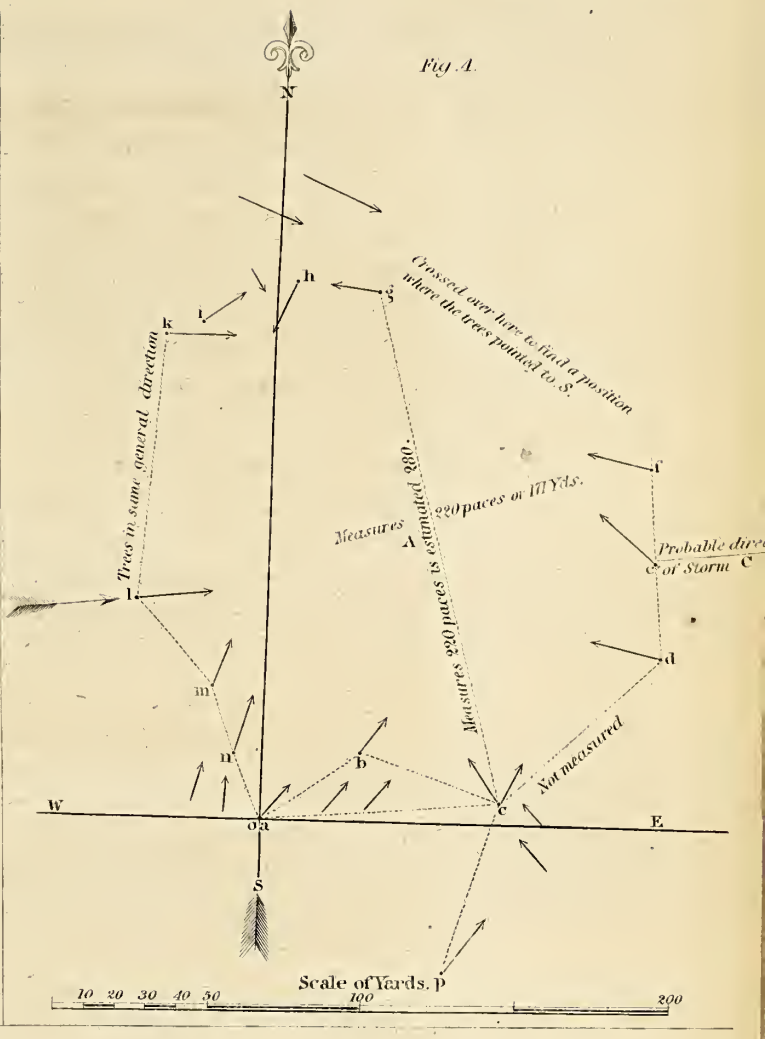


Fig. 3.

DWELLING &c. and ORCHARD of Mr D. POLHEMUS.

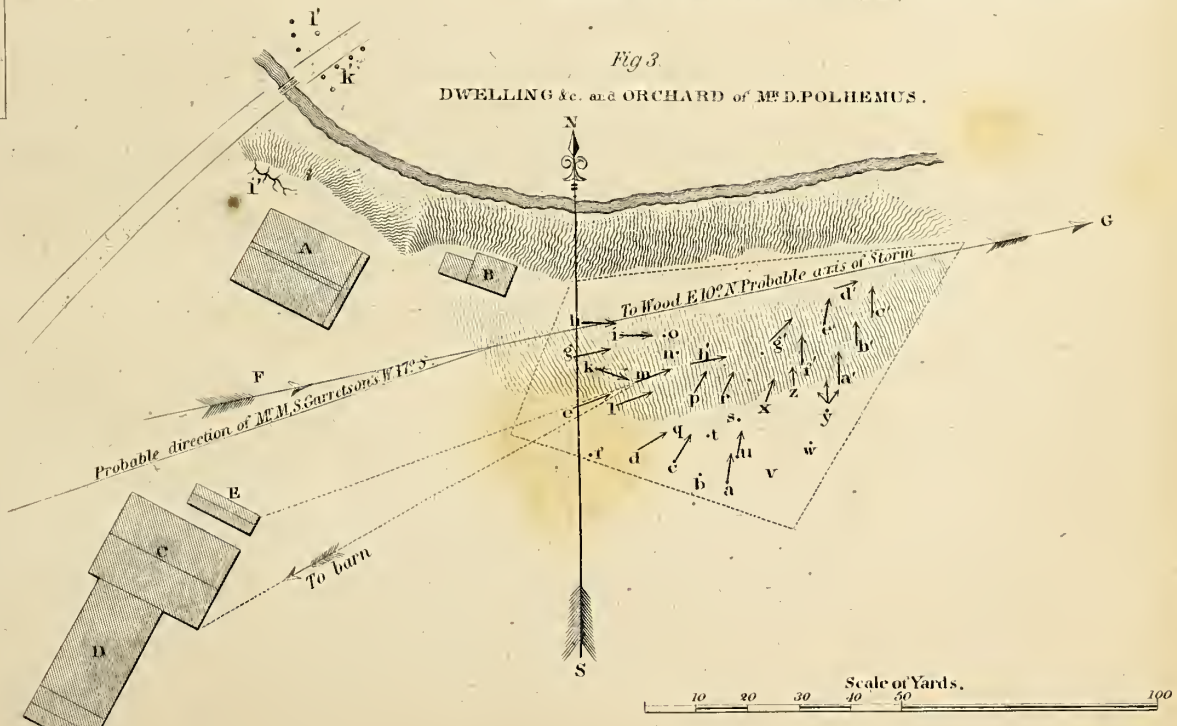


Fig. 6.

DWELLING & GROUNDS OF Mr D. DUNN.

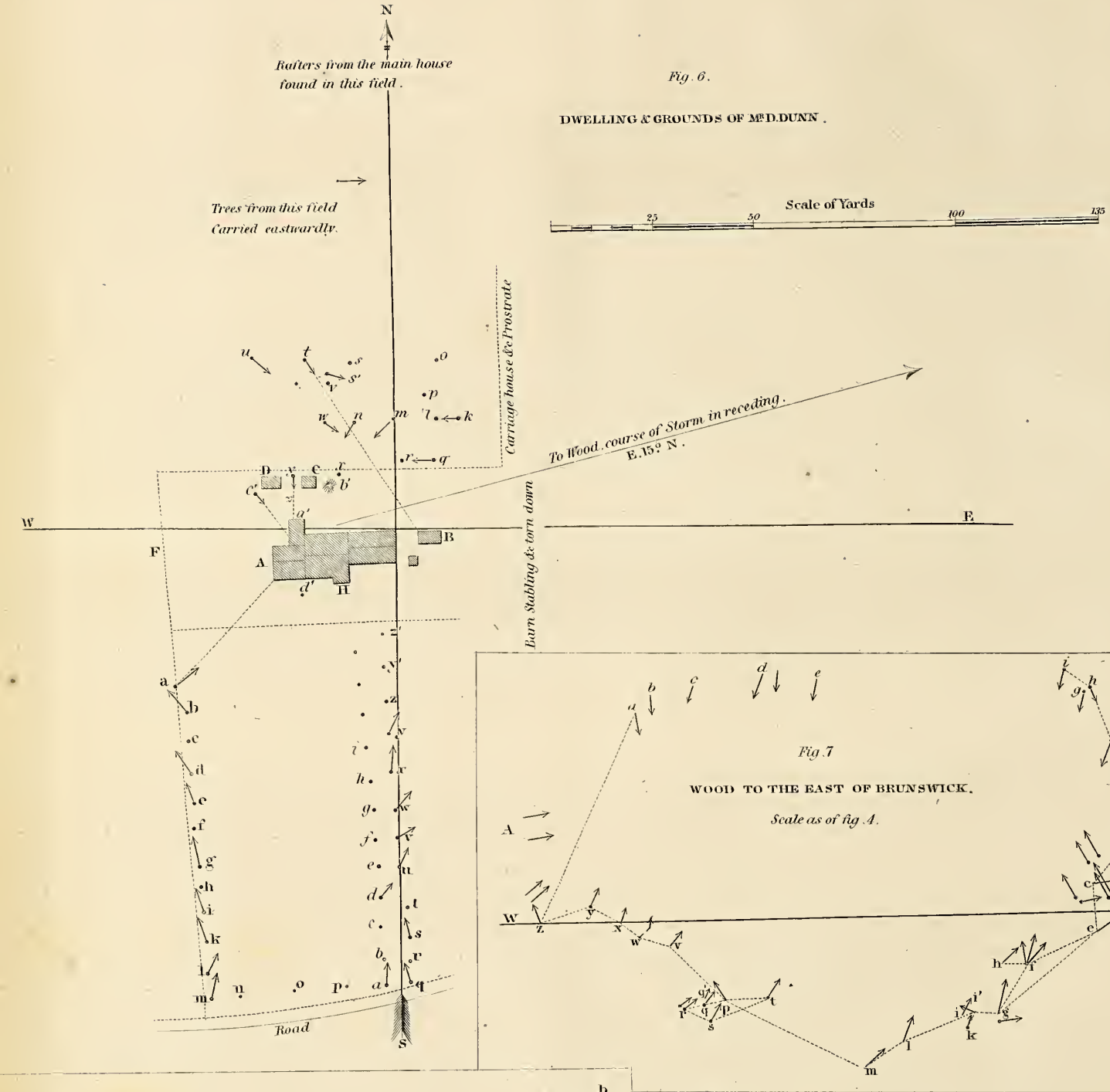
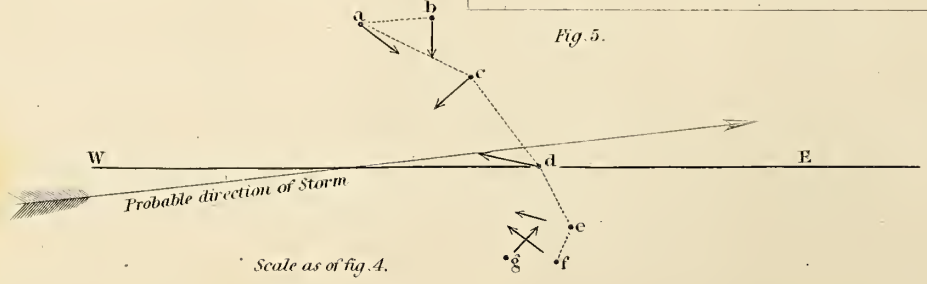


Fig. 7

WOOD TO THE EAST OF BRUNSWICK.

Scale as of fig. A.

Fig. 5.



Scale as of fig. A.

References to the Diagrams on Plate XXIV.

Figure 5.

A wood.

a. E. 35° S. Tall hickory broken off about fifteen feet from the root.
b. S. Also broken.
c. S. 31½° W.*
d. W. 9° N. Uprooted. A tree near to d is broken off and carried in the same general direction.
e. Broken off and carried W. 18° N. A tree near to this and west of north of it, carried in the same general direction.
f. A large rotten oak broken off, lying W. 36° N. Its trunk at the base, fifteen feet from the fracture, measures six and a half feet in circumference.
g. A broken tree lying over f and nearly at right angles to it.

Figure 6.

Dwelling and grounds of Mr David Dunn.

a. N. 40° E. A cherry tree. The west corner of the house is about one hundred feet off, and lies to N. 42½° E.
b. N. 20° W. A cherry tree uprooted.
c. Cherry tree of medium size, unbroken.
d. N. 22° W. A large cherry tree uprooted.
e. N. 19° W. Uprooted.
f. Small cherry tree standing.
g. Large cherry tree N. 4½° W.
h. Cherry tree of medium size, unhurt.
i. N. 10° W.
k. Black cherry tree N. 13½° W.
l. N. 23½° E.
m. Largest cherry tree in the row, N. 10½ E.
n. Large pear tree.
o. Broken off and cut since the storm.
p. A small tree standing. A tree on the opposite side of the road is broken off and the broken part lies to the northward.
q. A large black cherry tree lies N. 15° W.
r. Not taken.
s. Broken seven feet from the ground, and has fallen against t.
t. Not taken.
u. A large black cherry tree N. 18° E.
v. E. 30° N. Large black cherry tree, torn up and thrown from its bed.
w. N. 40° E. Black cherry tree.
x. N. 3° E. Smaller cherry tree.
y. N. 18½ E. Largest size.
z. Broken to north east.
y′. Standing.
z′. Broken.
a. N. 3° E. Very large black cherry tree.
b. Small tree not injured.
c. Larger than *b* not injured. Small.
d. Uprooted N. 45° E.
e. Small.
f. Medium size cherry tree. Not broken.
g. Broken limbs to east. A black walnut (?) tree.
h. Cherry tree broken.
i. Pear tree uprooted.
k. N. of house. W. 4° S. Small fruit tree fallen against *l*.
l. Stripped of leaves.
m. Pear tree uprooted, points, as shown in the figure, towards the house.
n. Ditto.
o. *p*. Broken fruit trees. Small.
q. Broken off and lying against *r*.
s′ Is the position of the broken part of *s*. It lies E. 7½° S.
t. Large pear tree, pointing as shown in figure.
u. Points to about ten feet east of the wash house B. It is a broken apple tree.
v. Broken pear tree, coated with dust on the north west side.
w. Large cherry tree broken off E. 27½° S. Its top lies with those of *m* and *n*.
x. A pear tree. Broken.
y. A black cherry tree, uprooted and thrown against *z*. Lies in the line *y z a′*.
z. Black cherry tree, dirt on the north east side of it. Broken on that side, its limbs lie parallel to the house.
C, D. Two outhouses to east and west of *z*. The timbers of the eastern outhouse C lie in the mass *b′*, which contains the tops of trees, &c. The windows of D are broken on the east, one on the west side is forced in. Clap-boards are off in part near the ground on the north side.
b′. A heap of rubbish left by the storm. Tops of trees *k*, *l*, *m*, &c., beams from C, &c.
e′. A tree lying as shown in the figure.
d′. To S. of house. A small tree broken and thrown against the porch H.
F. A fence to the west of the house prostrate, and in part carried against and into the west side of the house. All the trees and shrubs which were in this garden are prostrate or broken.

Figure 7.

A wood to the east of New Brunswick.

b. N. 26° W. Two oaks close together, uprooted. Trees to N. 26° W. of *b* lie in the same general direction.
c. E. 9° N. Trees near c and to west of b lie, some directed as c, others as b.
e. E. 36° N. A small oak, which may have been deflected by the trees against which it has fallen.
f. Three trees, smallest N. 38½° E. The largest has possibly been deflected by the trees against which it has fallen : it rests N. 18½° E. One to the west of the other two is rotten; it lies N. 3½° W. Smallest and largest not wholly uprooted.
g. N. 16½ E. Uprooted. A tree to the south of this inclines to the east.
h. E. 40° N.
i. W. 18° N.
i′. Two small trees uprooted, lying under i, N. 3° E.
k. Broken. Its top lies N. 10½° E. from the trunk. Crooked.
l. N. 6° E. The top of an oak. Broken off.
m. Top off. E. 32° N.
p. N. 16° W. Three oaks uprooted.
q. N. 30° E.
q′. To N. and E. from q. Broken, N. 35° E.
r. Two oaks uprooted, E. 36° N.
s. N. 23½° E.
t. N. 32½° E. Several others not 10° from this direction.
v. A broken oak, N. 44° E.
w. Top broken off and carried to north east. Direction of the stem of top N. 20° E.
x. N. 26° E.
y. N. 10° E.
z. Top carried to N. 39° W. Some trees near, lie to N. 40° E.
a. Lies S. 2½° E. Another, near it, is in the same general direction.
b. Nearly south. A rotten stump.
c. A sound tree broken to S. 35° W.
d. Uprooted to S. 36° W. Many like this to the east of it.
e. S. 28° W.
f. S. 14° W. This tree is north of the point a.
g. S. 12° W.
h. Very nearly S. 3° E.
i. S. 6½° W.

* The trees to the directions of which the angles refer, unless when the contrary is stated, were uprooted.